Treatment of a Deep Bite with Bilateral Palatally Impacted Maxillary Canines

Abstract

Impacted maxillary canines is a common malocclusion. A 14 year female presented with a Class I deep bite malocclusion, complicated with impacted maxillary canines, bilaterally. The right maxillary primary canine was retained. The Discrepancy Index (DI) for the malocclusion was 15, but 16 points were added for the difficult position of the impactions, resulting in a total DI of 31. Extraction of the primary canine prior to orthodontics treatment helped the axial inclination and position of the right impacted canine. After opening up space for the upper canines, surgical exposure was performed by a periodontist to remove the soft tissue and bone covering the crowns of the impactions to permit spontaneous eruption of the impactions. A cone-beam computed tomography (CBCT) image was obtained immediately prior to the surgery to provide accurate localization of the impactions relative to the adjacent teeth. Glass ionomer-cement bite turbos (GIBT) were bonded on the upper central incisors to open the bite at the beginning of active treatment. To allow the cuspids to pass out of crossbite, GIBTs were placed on the mandibular first molars and the bite turbos on the upper central incisors were removed. The patient's dentition was well aligned as evidenced by a Cast Radiograph Evaluation (CRE) of 18. The overall treatment time was 31 mo. Opening the bite with GIBTs is beneficial for patients with low to average divergency of the jaws, and competent lips. (Int J Orthod Implantol;39:4-19)

Key words:

Palatally impacted maxillary canines, surgical exposure, spontaneous eruption, CBCT, deep bite, Glass Ionomer Bite Turbos (GIBT)

History and Etiology

A 14 year-old female presented with bilateral unerupted maxillary canines and an over retained upper right primary canine (*Figs. 1-3*). Both medical and dental histories were noncontributory. The Discrepancy Index (*DI*) for the malocclusion was 15 using the American Board of Orthodontics (*ABO*) method. In addition, the difficult positions of the impactions scored an additional 16 points, resulting in an overall DI of 31. The scoring worksheets are at the end of this case report.

After a 2-year-and-7-months (31 months) of active treatment, the patient was corrected to a near ideal result (*Figs. 4-6*), with an ABO Cast Radiograph Evaluation (*CRE*) of 20. Pre-treatment and post-treatment cephalometric and panoramic radiographs document the corrected angulation and position of the upper canines after the treatment (*Figs. 7 and 8*). Cephalometric superimpositions reveal excessive growth in the mandible compared to the maxilla, which contributed to a Class III facial profile (*Fig. 9*). The photographic summary of the orthodontic treatment procedures is documented



Dr. Irene Yi-Hung Shih, Visiting Staff, Beauty Forever Dental Clinic (left)

Dr. John Jin-Jong Lin MS, Marquette University Chief Consultant of IJOI President of TAO (2000~2002) Author of Creative Orthodontics (middle)

W. Eugene Roberts, Chief editor, International Journal of Orthodontics & Implantology (right)



Fig. 4: Post-treatment facial photographs



Fig. 1: Pre-treatment facial photographs



Fig. 2: Pre-treatment intraoral photographs





Fig. 3: Pre-treatment study models (casts)

Fig. 5: Post-treatment intraoral photographs



Fig. 6: Post-treatment study models (casts)



Fig. 7: Pre-treatment cephalometric and panoramic radiographs



Fig. 8: Post-treatment cephalometric and panoramic radiographs



Fig. 9:

Pre-treatment (black) and post-treatment (red) cephalometric tracings are superimposed on the anterior cranial base (left), maxilla (upper right) and mandible (lower right).



📕 Fig. 10:

Bracket prescription: Low torque brackets on upper anteriors to get better torque control when opening space for the impacted canines. Standard torque was used on the lower anteriors.

in Figures 10-17. These procedures will be discussed in detail after a discussion of the special imaging and surgical requirements for the efficient recovery of maxillary canine impactions (*Figs. 18-22*). The particular attention to proclination and intrusion of the maxillary incisors to flatten the smile-arc is illustrated in Fig. 23.

Pretreatment, the maxillary impacted canines were distinctly palpated in the palate, but confirming the definitive positions of the impactions, relative to the adjacent teeth, required CBCT imaging (*Fig. 18*). In the absence of obvious anomalies and pathology in the maxillary arch, the etiology of the impactions was deemed to be abnormal paths of eruption.^{1,2} Surgical exposure was performed to uncover the impacted canines and remove bone from the planned path of extrusion. Six weeks after exposure, the maxillary cuspids erupted spontaneously, with sufficient crown exposure to permit the bonding of brackets (*Fig. 22*).

Diagnosis

Skeletal:

- Skeletal Class I (SNA 83.9°, SNB 84.1°, ANB -0.2°)
- Average mandibular plane angle (SN-MP 29.6°, FMA 24.0°)

Dental:

- Bilateral Class I molar relationship
- Overjet 2 mm
- Deep over bite >100% of lower incisor crown length (8 mm)
- 2 mm space deficiency in the upper arch
- 3.5 mm space deficiency in the lower arch
- Four developing wisdom teeth
- Upper dental midline was coincident with the facial midline; lower dental midline shifted to right ~1 mm
- Arch forms: symmetrical tapering ovoid shape in the maxilla and the mandible

Facial:

- Straight profile
- Acute nasolabial angle
- Vertical facial proportions are within normal limits (*WNL*)
- · Chin point slightly deviates to right

The ABO Discrepancy Index (*DI*) is 15, but 16 points were added for the difficult position of the impactions, for an overall DI of 31. See the subsequent worksheets for details

Treatment Objectives

Maxilla (all three planes):

- A P: Allow for normal expression of growth
- Vertical: Allow for normal expression of growth
- Transverse: Maintain

Mandible (all three planes):

- A P: Allow for normal expression of growth
- Vertical: Open slightly
- Transverse: Maintain

Maxillary Dentition:

- A P: Maintain
- Vertical: Slightly intrude upper incisors
- Transverse: Expand

Mandibular Dentition:

• A – P: Maintain

CEPHALOMETRIC			
SKELETAL ANAL	_YSIS		
	PRE-Tx	POST-Tx	DIFF.
SNA°	83.9°	83.1°	-0.8°
SNB°	84.1°	83.9°	-0.2°
ANB°	-0.2°	-0.8°	-0.6°
SN-MP°	29.6°	29.5°	-0.1°
FMA°	24.0°	24.1°	0.1°
DENTAL ANALY	'SIS		
U1 TO NA mm	4.2 mm	7.0 mm	2.8 mm
U1 TO SN°	98.3°	118.3°	20.0°
L1 TO NB mm	0.0 mm	3.1 mm	-3.1 mm
L1 TO MP°	70.1°	85.3°	15.2°
FACIAL ANALYS	SIS		
E-LINE UL	-1.0 mm	-3.2 mm	-2.2 mm
E-LINE LL	-0.7 mm	-0.7 mm	0.0 mm

- Table 1: Cephalometric summary
- Vertical: Maintain
- Transverse: Expand

Facial Esthetics:

Maintain

Treatment Plan

A non-extraction treatment approach with a full fixed orthodontic appliance was planned to align and level both arches. Low torque brackets were selected for the upper anteriors to prevent excessive flaring. An open window technique was planned to uncover the impacted canines, utilizing CBCT images for determining the precise position and orientation relative to adjacent teeth.

Appliances and Treatment Progress

The upper right primary canine was extracted prior to the surgical uncovering of the impactions. A full fixed .022" Damon Q[®] passive self-ligating (*PSL*) appliance (*Ormco, Glendora, CA*) was installed. Standard brackets were used for the lower arch, and low torque brackets were used on the upper incisors to prevent excessive flaring, when space was opened for the impacted canines (*Fig. 10*). The initial archwires were .014" CuNiTi on both arches. The deep bite was opened with GIBT (*Glass Ionomer Bite Turbos*) bonded on the lingual surfaces of the upper central incisors (*Fig. 11*). Starting from the 2nd month of treatment, cross arch elastics were placed from

the lingual surfaces of the lower second premolars and first molars to the buccal side of the upper first premolars and first molars to decrease the buccal overjet and upright the lower posterior teeth.

The archwire sequence progressed to .014x.025" CuNiTi in three months. During arch alignment open coil springs were installed to open space for the impacted canines (*Fig. 12*). In the 7th month of treatment, the patient was referred to a periodontist for surgical exposure of both palatal impactions. Before this surgery, CBCT images were used to confirm the definitive localization of the impactions and their relationship to the adjacent teeth (*Fig. 18*).



📕 Fig. 11.

U & L bonding: .014" CuNiTi archwires were used for both arches. The deep overbite was opened with GIBT (Glass Ionomer Bite Turbos) bonded on the lingual surfaces of the maxillary central incisors.



Fig. 12:

Upper arch: .014x.025" CuNiTi with open coil spring to open up space for the maxillary canines.

Two weeks after the surgery, the upper canines erupted spontaneously about 3~5 mm and were clearly visible in the palate (*Fig. 21*). Both maxillary canines were bonded with low torque brackets five months after the surgical exposure. At the same appointment, GIBTs were bonded on the lower first molars and the previous GIBTs were removed from the palatal surface of the maxillary central incisors (*Fig. 13*). Three months later, a crown lengthening operation was performed on both maxillary canines to remove the labial soft tissue prior to repositioning the brackets (*Fig. 14*). Open coil springs were used as needed to open space to align all teeth in both arches (*Figs. 15 & 16*). Two months before debonding, the finishing and detailing was accomplished by repositioning the brackets (*Fig. 17*). In the 31st month of treatment, all fixed appliances were removed.

Results Achieved

The patient was treated to the planned result, as documented by cephalometric radiograph superimpositions (*Figs. 4, 5, 6 and 8*). For an over 14 year old female, there was a surprisingly large



Fig. 13:

Five months after surgical exposure, [#]13 & 23 were bonded with low torque brackets to enhance labial root torque while aligning the palatally displaced canines to the labial and GIBT were bonded on lower first molars.



Fig. 14:

Crown lengthening operation to remove the excess labial soft tissue on the maxillary canines was carried out before repositioning the brackets.



Fig. 15: Multiple open coil springs are used to open space for optimal alignment of the maxillary dentition.



Fig. 16: Positive overjet for the previously impacted maxillary canines was achieved eight months after they were bonded.



Fig. 17: Two months before debonding, finishing and detailing were accomplished with bracket repositioning.

amount of facial growth, as evidenced by ~5mm increase in mandibular length. A summary of the cephalometric measurements is provided in Table 1.

The ABO Cast-Radiograph Evaluation (*CRE*) was 20 as shown in the subsequent worksheet.

Maxilla (all three planes):

- A P: Increased
- Vertical: Increased
- Transverse: Maintained

Mandible (all three planes):

- A P: Maintained
- Vertical: Increased
- Transverse: Maintained

Maxillary Dentition:

- A P: Proclined incisors
- Vertical: Upper incisors were intruded
- Transverse: Expanded

Mandibular Dentition:

- A P: Increased axial inclination of the incisors
- Vertical: Compensatory extrusion of the lower arch with normal expression of growth
- Transverse: Expanded

Facial Esthetics:

• Lower facial height increased due to normal expression of facial growth

Retention

Upper clear removable and lower 4-4 fixed retainers were delivered. The patient was instructed to wear the upper clear retainer full time for the first six months and nights only thereafter. In addition, the patient was instructed in proper home hygiene and maintenance of the retainers.

Final Evaluation of the Treatment

In general, both upper and lower arches were ideally aligned in a Class I relationship with good



Fig. 18:

CBCT images were taken before surgery to confirm the position of the impactions and their relationships with the adjacent teeth.

interdigitation. The deep overbite was reduced from 100% (*8mm*) to 25% (*2mm*), and the overjet was well maintained with incisors in contact. The CRE score was 20 points, reflecting problems in alignment/ rotation of canines, marginal ridge discrepancies of the lower 1st and 2nd molars, lack of occlusal contacts, and axial inclination discrepancies for the mandibular 1st molars.

Discussion

The maxillary canine is the second most common impaction, following the third molars. Most third molars are expendable, but maxillary canines are important dental units for both function and esthetics. When they are impacted, they may compromise adjacent teeth. Therefore, management of upper canine impaction is a routine but critically important task for orthodontists. It has been reported that 85% of maxillary canine impactions are on the palatal surface, but only 15% are positioned labially. Radiographic evaluation in late mixed dentition may reveal the potential for impactions.^{3,4} According to a study of unerupted canines, the depth of the cusp tip, its proximity to the midline, and the degree of horizontal orientation were positively correlated with the length of treatment time to recover the impacted teeth.^{5,6} Interceptive treatment involves extraction of the primary canines and opening space for the impacted teeth. Furthermore, Ericsson and Kurol⁷⁻⁹ reported that extraction of the primary canines between the age of 10 and 13 usually simplifies treatment and enhances the outcome.

For the present patient, the cusp tips of the impacted canines overlapped the midline of the lateral incisors bilaterally, indicating that the chance of self-eruption was only ~64%. Although the upper right permanent canine remained impacted, the cusp tip tilted inferiorly and the tooth axis improved, four months after extracting the primary canine. This self-correction of an impacted canine often occurs after obstacles are removed from the path of eruption (*Figs. 19 & 20*). Furthermore, the self-



📕 Fig. 19:

- Left: The cusp tip of upper right canine was superior to than that of left canine. The crowns of the impacted canines extended to the palatal surface of the central incisors.
- Right: An over-retained upper right primary canine interferes with the desired path of eruption for the impacted permanent right canine.



Fig. 20.

Left: Four months after the upper right primary canine extraction, the cusps tips of the right canine had moved inferiorly and its axial inclination had improved.

Right: Adequate space has been opened to align the impactions.



Fig. 21: The upper canines began to erupt spontaneously two weeks after surgical uncovering.



Fig. 22: Six weeks after surgical exposure operation, the previous impacted maxillary canines are continuing to erupt.

correction of both the position and angulation improved the potential for recovering the impacted canines.

Removing the palatal soft and hard tissue in the path of eruption is essential for predictable spontaneous eruption.¹⁰⁻¹² CBCT imaging is more sensitive than conventional radiography for both canine localization and the identification of root resorption on adjacent teeth.¹³ The surgery may be performed after opening space for the impacted tooth or teeth. Treatment time is substantially reduced when the bonding of fixed orthodontic appliances is delayed until the canine has erupted into the palate.¹⁴

GIBTs on the central incisors were used in the present patient to achieve vertical control of the 100% deep bite. Although an equal and opposite force was applied to upper and lower incisors, more intrusion occurred for the upper incisors in this growing patient, resulting in a decreased incisal exposure as the facial height increased (*Figs. 9, 23 &*

24). The follow-up crown lengthening procedure for the maxillary canines may have been avoided if the teeth had erupted further prior to bonding, but that approach may have complicated the correction of the canine crossbites.

When palatally impacted canines are moved labially, the chances of soft tissue accumulation on the facial surface is high. Therefore, the patient should be prepared in advance for the probable crown lengthening surgery. In many instances, the excess soft tissue can be simply removed with a diode laser.¹⁴

Conclusion

In conclusion, the management of palatally impacted canines is a common challenge in orthodontics. Early detection of impacted maxillary canines, and extraction of the primary canine extraction, often improves the position and axial inclination of the impaction(s). CBCT imaging is



Fig. 23:

Intrusion and increased axial inclination on upper incisors during treatment is documented with pre-treatment and post-treatment cephalometric films.

important for defining the position of the impactions and assessing potential damage to adjacent teeth. Proper uncovering of the impacted maxillary canines by removing all soft and hard tissue in the path of eruption is essential for achieving a favorable spontaneous eruption. The latter usually results in at least some self-correction of the long axis of the impactions, which considerably simplifies alignment with fixed appliances.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 15+16=31*

OVERJET

0 mm. (edge-to-edge)	=	
1 – 3 mm.	=	0 pts.
3.1 – 5 mm.	=	2 pts.
5.1 – 7 mm.	=	3 pts.
7.1 – 9 mm.	=	4 pts.
> 9 mm.	=	5 pts.

Negative OJ (x-bite) 1 pt. per mm. per tooth =



0 - 3 mm.	=	0 pts.
3.1 – 5 mm.	=	2 pts.
5.1 – 7 mm.	=	3 pts.
Impinging (100%)	=	5 pts.
Total	=	5

ANTERIOR OPEN BITE

0 mm. (edge-to-edge), 1 pt. per tooth then 1 pt. per additional full mm. per tooth

Total
rotar

=

0

LATERAL OPEN BITE

2 pts. per mm. per tooth

Total

= 0

CROWDING (only one arch)

1 – 3 mm. 3.1 – 5 mm. 5.1 – 7 mm. > 7 mm.	= = =	1 pt. 2 pts. 4 pts. 7 pts.
Total	=	2

OCCLUSION

Class I to end on End on Class II or III Full Class II or III Beyond Class II or III	= = =	0 pts. 2 pts. per sidepts. 4 pts. per sidepts. 1 pt. per mmpts. additional
Total	=	0

LINGUAL POSTERIOR X-BITE			
1 pt. per tooth Total = 0			
BUCCAL POSTERIOR X-BITE			
2 pts. per tooth Total = 0			
<u>CEPHALOMETRICS</u> (See Instructions)			
ANB $\geq 6^{\circ}$ or $\leq -2^{\circ}$ = 4 pts.			
Each degree $< -2^{\circ}$ x 1 pt. =			
Each degree $> 6^{\circ}$ x 1 pt. =			
SN-MP $\geq 38^{\circ} = 2 \text{ pts.}$ Each degree $\geq 38^{\circ} x 2 \text{ pts.} =$ $\leq 26^{\circ} = 1 \text{ pt.}$ Each degree $\leq 26^{\circ} x 1 \text{ pt.} =$ 1 to MP $\geq 99^{\circ} = 1 \text{ pt.}$ Each degree $\geq 99^{\circ} x 1 \text{ pt.} =$ Total = 0 OTHER (See Instructions)			
Supernumerary teethx 1 pt. =Ankylosis of perm. teethx 2 pts. =Anomalous morphologyx 2 pts. =Impaction (except 3 rd molars)2 x 2 pts. =Midline discrepancy (\geq 3mm)@ 2 pts. =Missing teeth (except 3 rd molars)x 1 pts. =Missing teeth, congenitalx 2 pts. =Spacing (4 or more, per arch)x 2 pts. =Spacing (Mx cent. diastema \geq 2mm)@ 2 pts. =Tooth transpositionx 2 pts. =Skeletal asymmetry (nonsurgical tx)@ 3 pts. =Addl. treatment complexities2 x 2 pts. =Identify:Surgical exposure was performed to uncover the impacted maxillary canines.Total=8			

* The additional 16 points is from the subsequent Impaction Discrepancy Index



INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

Impaction Discrepancy Index : 16

1. Angulation of the canine to the middle in degree



Grade 1: $0^{\circ} \sim 15^{\circ}$ = 1pt.Grade 2: $16^{\circ} \sim 30^{\circ}$ = 2pts.Grade 3: $\geq 31^{\circ}$ = 3pts.





2. Vertical distance from the occlusal plane





Grade 1: Below the level of the CEJ	= 1pt.
Grade 2: Above the CEJ, but less than halfway up the root	= 2pts.
Grade 3: More than halfway up the root, but less than the full root length	= 3pts.
Grade 4: Above the full length of the root	= 4pts.

Total = 2x2 = 4

2. Mesiodistal position of the canine tip



Grade 1: No horizontal overlap Grade 2: Overlap with lateral incisor Grade 3: Overlap with central incisor



